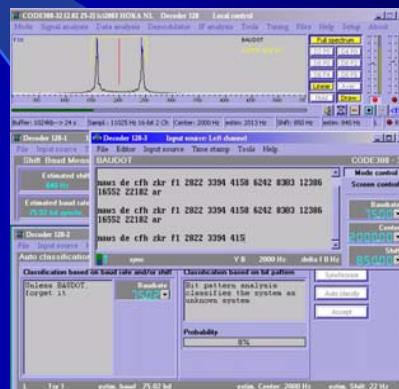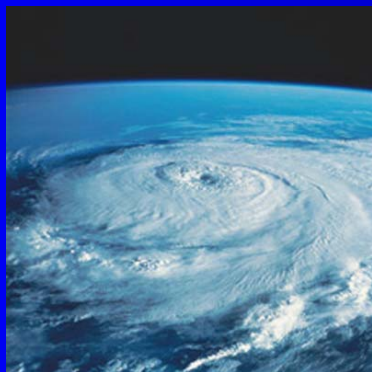# MORCOM International, Inc. -

# Here's our world . . . .

# Here's who we are . . . .

- **Founded in 1984 to provide equipment and services to clients in the Federal and commercial marketplace**

- **The company is a strong, stable, well funded firm with highly capable management and professional staff**

- **The company goes <u>beyond</u> supplying products. We provide services to support our products**

  - **Information systems development**
  - **Infrastructure planning**
  - **Network planning**
  - **Operations and maintenance support**
  - **Training**

MORCOM
INTERNATIONAL, INC.

# Here's more of who we are . . . .

- Since we are small, we are <u>highly</u> <u>responsive</u> and eager to engage...

- The company has the 8(a) certification vehicle allowing quick access for our products and services to Federal clients

- We not only build systems, but foster strong customer relations

- Morcom hires and retains the best technical and engineering talent who are available personally or online to understand and support your requirements

# Here's what we do . . . .

- **Provide a broad range of mission critical high technology communication products**
    - **Land mobile radio communications**
    - **Aeronautical radios**
    - **Weather information systems**
    - **Data collection systems**

- **Provide communication systems installation, operations support, maintenance and training services**

- **Conduct Information Technology (IT) equipment requirements analysis, design, and computer network support**

MORCOM
INTERNATIONAL, INC.

# Here's more of what we do . . . .

- We conduct engineering and feasibility studies using advanced technologies such as satellites and wireless components for the management of the environment

- We provide appropriate state-of-the-technology hardware and software for optimal performance to your requirements

- We are a total hardware and software system integrator

- We provide a worldwide network of representatives to install and support our systems

- We could provide vital interoperable communications links that bind our Homeland Security Infrastructure

MORCOM
INTERNATIONAL, INC.

# Here are some of our products . . . .

- **Land mobile radio communications**
  - **Two-way transceivers**
  - **Mobile & base station antennas**
  - **Surveillance receivers and DF systems**
  - **Wireless WAN and LAN equipment**
- **Aeronautical Communications**
  - **VHF/UHF Transceivers**
  - **Automatic Terminal Information Service (ATIS) Systems**
  - **Air band antennas**
- **Weather information systems**
  - **Digital weather stations**
  - **Mobile weather system for HAZMAT applications**
  - **Weather information terminals (NOAA Port, WAFS etc.)**

MORCOM
INTERNATIONAL, INC.

# Here are some of our services . . . .

- Communication systems design

- Airport ground to air communications support services

- Weather information systems design

- IT hardware support and management

- Repair and programming of radio transceivers

- Hydro-meteorological system design and support

- Airport weather observation systems design and support

- ATIS system design and support for airports

- Export/Import consulting services

# GOES DCS CDMA Over Lay Study

- Study Commenced September 2003
- Objective is to determine the feasibility of a coexisting CDMA design.
- Study includes theoretical , bench test equipment and over air tests
- Morcom is working in partnership with uCom.

# Study is to Determine and Substantiate

- If a CDMA design that is of value to users can be supported with the TDMA / FDMA operation?

- How is the CDMA data flow to be integrated into DAPS I,II?

- What might be a DCP Cert Standard for CDMA?

- What would be an operational concept?

# Study Links Include

- DCP R

- DCP I as a subset

# Ground Rules

- Insignificant loss of performance on a properly operating DCP in the FDMA TDMA regime.

- Added capability must be of significance.
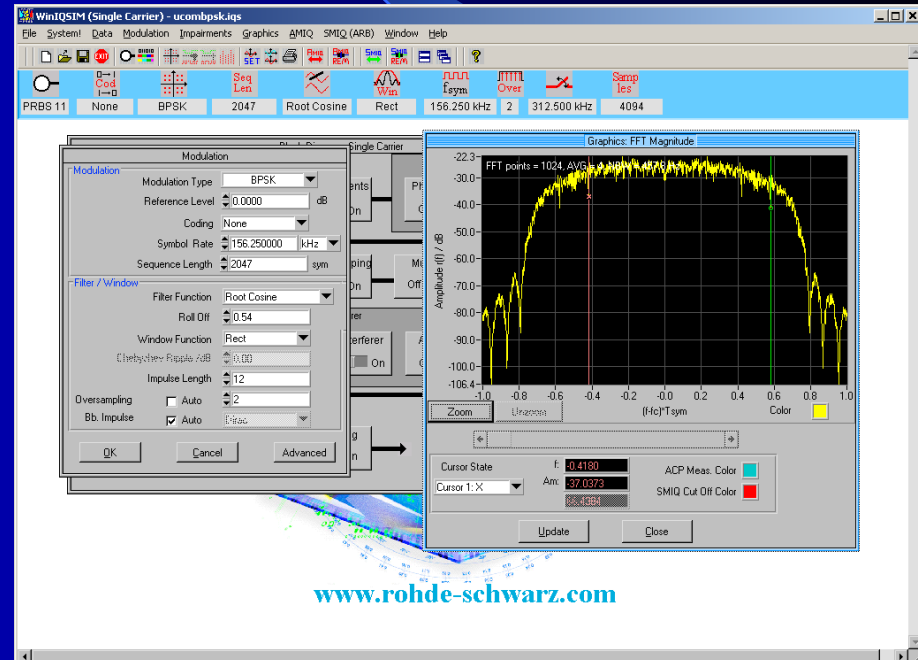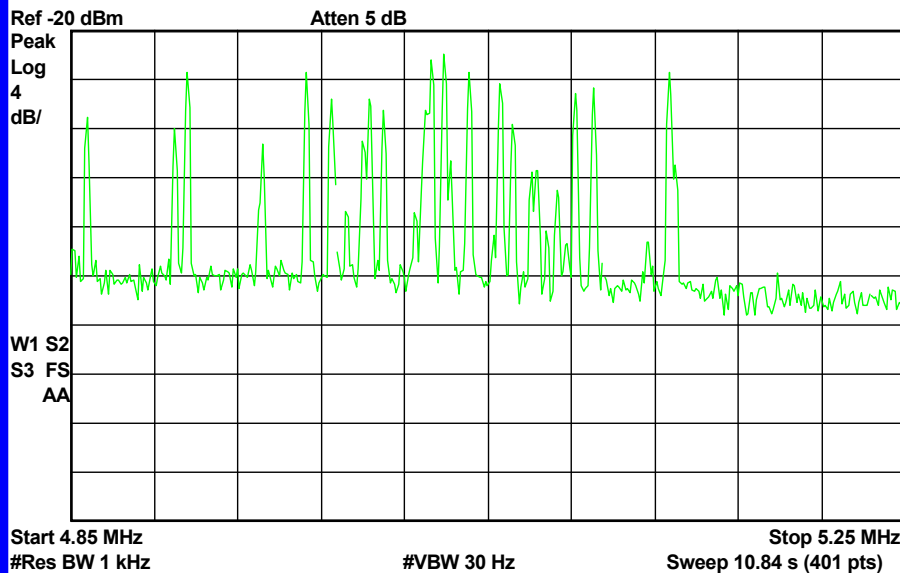
# Significance ?

- Can support 1,000,000 messages per day of 500 bits each.
- Provides user advantages in:
  - Cost
  - Power
  - Message reliability
  - Ease of use
    - Eased Frequency Control
    - Eased time keeping (watch crystal)
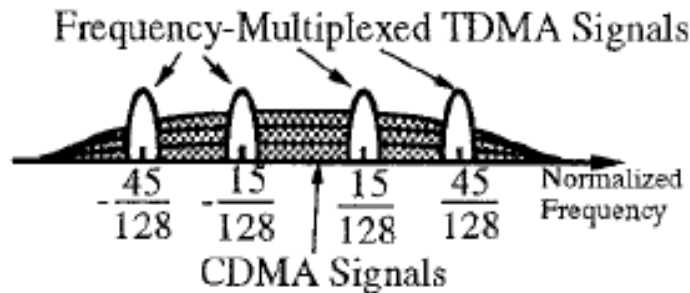
# CDMA Characteristics

- Resistant to interference
- Support Multiple User Access through coding signatures
- Makes use of the entire spectrum that is available, low density power spectra.
- Power sharing can be a statistical process
- Graceful performance degradation.

# Spectral Examples
# GOES E & CDMA

# Combined Spectrum



Frequency-Multiplexed TDMA Signals

$-\dfrac{45}{128}$ $-\dfrac{15}{128}$ $\dfrac{15}{128}$ $\dfrac{45}{128}$ Normalized Frequency

CDMA Signals

(a) CDMA Signals and 4 TDMA Signals



DS-CDMA/TDMA Frequency Sharing System with Notch Filter

TDMA System

DS-CDMA System

DS-CDMA/TDMA Frequency Sharing System without Notch Filter

$BER = 10^5$   $C/N_0W_S = 10dB$
$Gp = 127$   $\rho = -10dB$
$V = 0.35$   $a = 0.33$

Spectral Efficiency

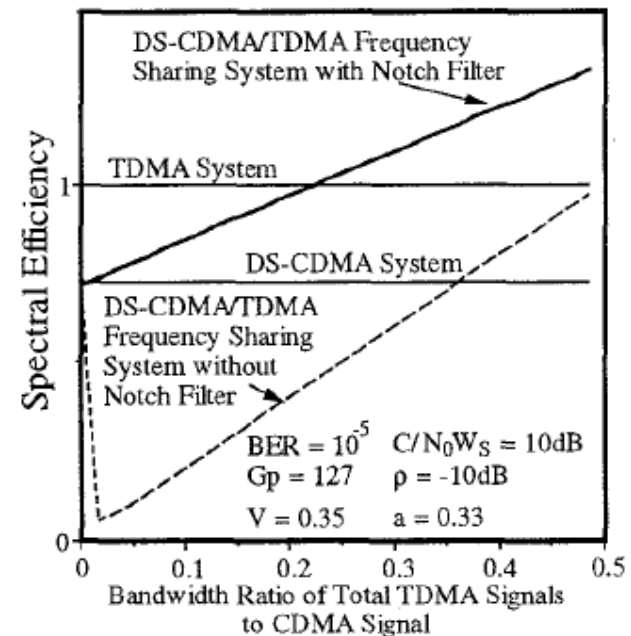Bandwidth Ratio of Total TDMA Signals to CDMA Signal

Figure 8    Spectral Efficiency of DS-CDMA/TDMA Frequency Sharing System

# Spreading 1

- Current 100 BPS uses a spreading ratio of 2 by employing Manchester Clock Encoding
- Spreading is the multiplication of the data or symbol rate by a synchronous code
- This code has been called the "Signature Code"
- The RX uses apriori knowledge of the code to recover the signal

# Spreading 2

- TX power is spread in direct proportion to the spreading ratio across the spectrum
- The spreading ratio is the number of bits by which each data symbol is multiplied
- Interference rejection is proportional to the square root of the spreading ratio.
- This rejection is both from other CDMA TXes and FDMA / TDMA TXes

# And So?

- Maximize spreading ratio by
  - Maximum spectrum use
  - Minimum Data Rate
- Results In
  - A maximum number of simultaneous CDMA "Channels"
  - Least interference with FDMA – TDMA
  - Least interference from FDMA - TDMA

# What Are Some Numbers ?

- CDMA Initial EIRP of 37 dBm

- Spreading ratio of 2000 (-33 dB)

- Data Rate of 100 BPS

- 50 Simultaneous TXes (+17 dB)

- Results in a noise floor 29 dB below a 1200 BPS TX at 50 dBm EIRP

- This is worst case and about 10 dB below the current noise floor.

# Hypothetical Operational Concept

- Each TX has a unique code (Tied to ID?)
- Assume a 15 minute TX interval is desired.
- Each message is limited to <4.5 seconds
- Assume 50 simultaneous TXes
- Each TX sends on a uniform distribution of TX times
- Results in 10000 DCPs (50 X 900/4.5)
- Sending 960000 messages per day

# The Good , Bad, and Ugly

- Good
  - Minimum time keeping capability
  - Eased frequency control
  - Power consumption to 10s of milliwatts
- Bad
  - Data rate will be modest 100 to 200 BPS, careful use of format and sensor data needed.
- Ugly
  - Statistical System Management

# Processing

- Initial restricted to BPSK

- Interference rejection from spreading ratio only

# Future Improvements?

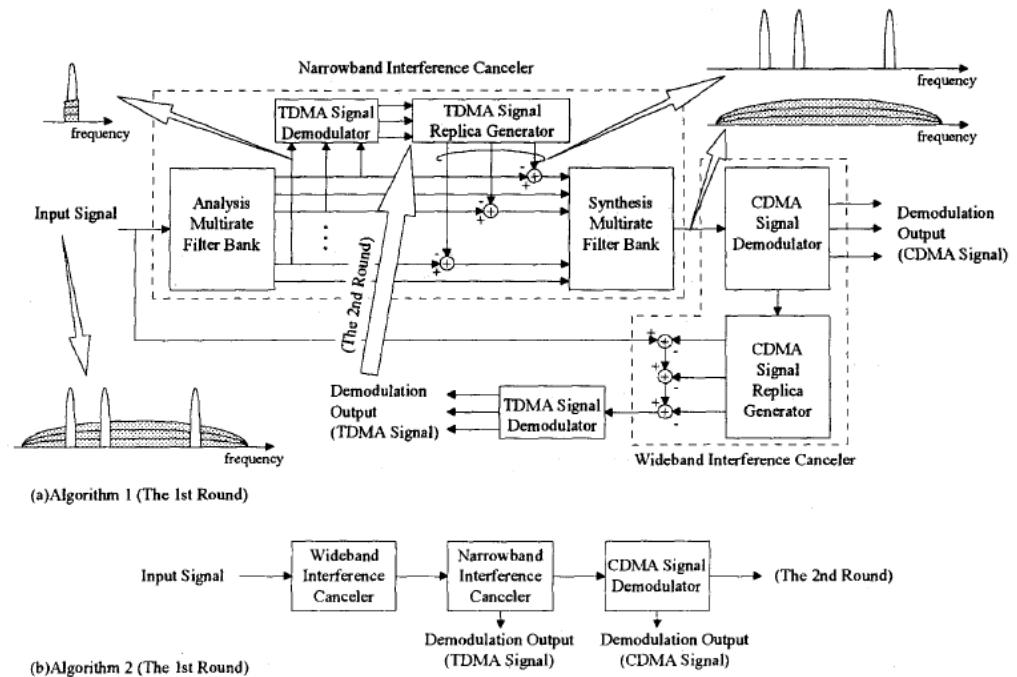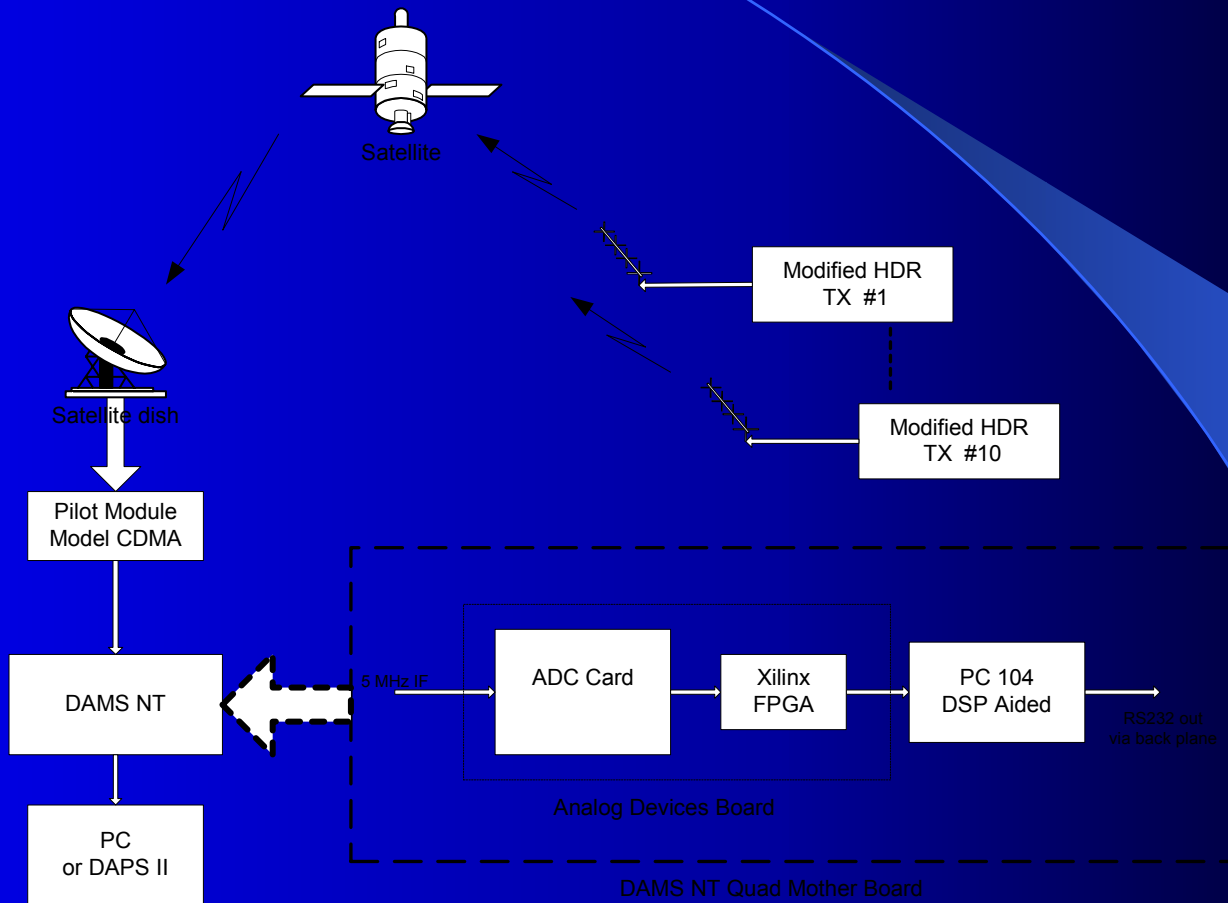- Improvements are susceptible to EXTREME signal processing



Fig. 4 Block Diagram of Narrowband/Wideband Interference Canceler

# Final Phase of Project



**CDMA Over lay System Test Using Microcom DRGS or Wallops CDA**